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ABSTRACT

This literature review surveys research on workplace substance abuse conducted in accordance with methodologically sound principles. It evaluates individual studies for the appropriateness of their designs, methods of substance detection, generalizability of findings, and the appropriateness of their conclusions. An attempt is made to determine the prevalence of substance use, the characteristics of substance abusers, the types of jobs associated with high rates of substance abuse, and the consequences of using substances in the workplace. Findings are presented from both self-report and urinalysis studies in order to develop a range of prevalence estimates. The review concludes that nationally representative self-report studies largely agree on a five percent prevalence estimate for on-the-job use of marijuana and that large-scale urinalysis reports generally concur with self-report findings. In another study, the U.S. Department of Labor produced an overall drug use estimate of nine percent by compiling the detection rates of over 7,500 U.S. companies with drug testing programs. Demographic studies are cited which showed that age is the strongest predictor of substance use, followed by sex, education, race, and geographic region; the most likely drug users in the workplace are white male high school dropouts 18-34 years of age in the western United States. Finally, it is concluded that the consequences of substance use appear to include increased absenteeism, tardiness, and possibly accidents on the job. (NB)

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A CROSS-DISCIPLINARY INTEGRATIVE SUMMARY OF RESEARCH ON WORKPLACE SUBSTANCE ABUSE

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WP-009

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America has been fighting a war against drug and alcohol abuse since its colonial origins. Today, the battle being waged over substances, both licit and illicit, pitches two substantial and powerful opponents against each other. On one side are people who profit from drug use. The tremendous demand for illicit drugs and alcohol has motivated farmers to develop stronger strains of marijuana, chemists to develop new, more powerful designer drugs, and alcohol and tobacco companies to create persuasive commercials to convince people that smoking and drinking are necessary social accoutrements. Opposing this side, we find that police arrested 104 million people on drug charges in 1989, and 20 percent of the total budgets of local and state law enforcement agencies is being spent enforcing drug laws (as cited by Harwood, 1991).

The status of success in this war can be measured statistically. 36.6% of those asked in a 1988 survey of U. S. Households claimed to have used an illicit drug at least once in their lifetime (U.S Department of Health and Human Services, 1988). That rate increases to nearly seventy percent for males between 26 and 34 years of age. Thirty-three percent of the population has tried marijuana, and over 10% have tried cocaine (Voss, 1989). The Federal government is also involved, allocating 10.5 billion dollars for drug control in fiscal year 1991. Seventy-one percent of this allocation went to controlling the supply and the other 29 percent went to treatment and education (Harwood, 1991). As the government flexes its muscles in the face of a more addictive and pervasive opponent, substance use draws the concern of employers troubled by the potential effects of substance use on their employees. A variety of critical questions arise out of this concern. What is the prevalence of substance use in the workplace? Are there workplace characteristics that increase or decrease the likelihood of substance abuse? What kinds of people are most likely to abuse drugs while at work? Are there performance characteristics that are indicative

of substance abuse? How should workplace substance abuse be identified? Along with these questions employers want to know the extent to which substances in the workplace affect productivity.

General public concern about substance use in the workplace has also grown recently as news coverage of events such as the Exxon Valdez incident capture worldwide attention. And the press is not the only public body drawing attention to workplace substance use. A Senate subcommittee identified workplace substance abuse as the principle reason for declines in U.S. worker productivity over the past two decades (Quayle, 1983). Although governmental and public discourse might seem to contain answers to many questions about workplace substance abuse, business leaders may not want to make employment decisions or create corporate policies based either on the reactionary opinions of the general populace or on the testimonial kinds of data presented to Senate subcommittees. Emotionally charged topics like workplace substance abuse invite precisely the level of conjecture, speculation, and inference that makes it crucial to apply scientific methods. For instance, since the Exxon Valdez incident and the spate of investigative journalism it spawned, scientific data on the incidence of alcohol use among oil tanker crew members seem irrelevant. The "outrage factor" resulting from that terrible tragedy makes it heretical even to ask whether the actual incidence and consequences of alcohol use on oil tankers warrants the expense and invasion of privacy entailed by drug screening, background investigations, and routine, mandatory treatment.

Tempering these subjective urges, scientific research has been conducted to answer some of the questions posed above. However, this research, too, must be carefully scrutinized before any conclusions, no matter how tentative, can be reached. It is the purpose of this review to survey research that has been conducted in accordance with methodologically sound principles. We will evaluate individual

studies for the appropriateness of their designs, their methods of substance detection, the generalizability of their findings beyond the particular sample studied, as well as the appropriateness of the conclusions reached by their authors. With such strengths and limitations in mind, we will try to determine the prevalence of substance use, the characteristics of substance abusers, the types of jobs associated with high rates of substance abuse, and the consequences of using substances in the workplace.

At the risk of preempting the more detailed analysis, it is worth noting at the outset that when we planned this review, we intended to select only the best of the available research, to compile the individual findings, and to create reliable ranges within which to place estimates of the prevalence and consequences of drug use. However, studies of representative samples proved to be scarce. On top of that, because they relied on self-report measures, the validity of these studies' findings turns on the honesty of those questioned and the observance of strict surveying techniques. Urinalysis studies provided more reliable and potentially more valid findings, but studies using these methods were generally conducted on nonrandom samples of job applicants or people involved in accidents on the job. That is, they really weren't designed to determine the prevalence and correlates of substance use; their purpose was to act as a deterrent to substance use and to identify employees using drugs. Confronted by either self-report based or nonrandom estimates, studies of individual companies became critical to our review. Because these findings may generalize poorly, we elected to feature in this review only higher quality individual studies with the hope that idiosyncratic biases would cancel one another out, leaving behind a consistent image of the nature of workplace substance abuse. Where appropriate, however, the methodological flaws, are indicated.

How Was the Literature Search Conducted?

We began with a search of computerized research databases in psychology, medicine, government, and business. Due to changing trends in substance use, we limited our original search to research published since 1983 so that our findings would be current. These articles were then hand reviewed for references to relevant publications missed by the computer search. Research conducted before 1983 that was considered particularly relevant was also included at this stage.

How Can the Prevalence of Illicit Drugs and Alcohol in the Workplace be Determined?

Estimates of the prevalence of substance use in the workplace can be determined following a number of different methods. Self-reports from workers themselves form the largest, though not necessarily the best, source of information. The major impediment to self-report validity is probably respondent honesty, and even honesty is no guarantee of validity. As McDaniel (1988) points out, even truthful respondents may misreport substance use. The respondent must know what drug was consumed in order to report it accurately. This is a potentially large problem because illicit drugs are often sold under pseudonyms such as 'black beauties' for amphetamines. The honest respondent must also recall the substance use. Questions aimed at substance use over the past week or month are likely to be less susceptible to faulty respondent memories, but if the survey asks for first usage or frequency over the past six months, the accuracy of estimates may deteriorate. Self-report based estimates of substance use may be influenced by respondent's motivations. Sherman and Bigelow, (1991) studied 150 patients enrolling for outpatient opioid detoxification at a treatment research clinic and found that for these people, self-reported drug use correlated well with same day urinalyses. A follow up

study of 70 patients comparing self-reports of drug use over a four week period with periodical urinalyses found variations in the agreement between self-reports and urinalyses. These variations suggest that external factors may motivate inaccurate reporting by people. For drug use self-reports, this is a large concern. However, arguments continue with some researchers claiming that drug use self-reports are reliable and valid (Smart & Jarvis, 1981; O'Malley et al., 1983). Addressing this issue, Ball (1967) compared the responses of 59 narcotic drug addicts on a structured interview with hospital records, FBI records, and urine tests conducted immediately after the interview. A high level of agreement between interview data and external criteria suggests that self-report data can validly be used to estimate substance use. Besides self-reports of drug use, surveys have also sought out managerial estimates of substance use in their companies as well as coworker estimates. Such surveys are susceptible to the same memory problems and motivated inaccurate reporting of self-report measures.

The second major type of research aimed at estimating substance use in the workplace uses blood and urine testing. While this form of testing provides accurate estimates of the presence of illicit substances in the urine and blood of those tested, the residual chemical markers that the urine and blood tests detect remain in the body for several days or weeks. Positive blood and urine tests can therefore indicate the presence of a chemical but not when or where it was ingested. In addition, negative findings can result when people prepare for such tests by uncharacteristically abstaining from substance use. Pre-employment drug testing is particularly vulnerable to these temporal constraints. Subjects are generally notified that a drug test will be performed at the time of the initial employment interview. Thus, these tests may underestimate use because casual users can stop their use before the drug test. The second form of urinalysis testing takes the form of testing for cause. These tests take

place following abnormal behavior (i.e., accidents) on the job. They may over-estimate workplace substance use by detecting casual users who do not use drugs on the job but do use them over weekends or on vacations. For these sorts of reasons, urinalysis testing was never intended as a method for estimating substance prevalence rates (Cook, 1989). Tests are generally performed on applicants, not employees, and rarely on nonrandom samples. These nonrandom samples make generalizing to the general workforce dubious. However, the relative paucity of other kinds of data and the suggestion that these others are equally inaccurate compels an examination of urinalysis findings. Before doing so, however, it is worth providing some detail on how such tests are conducted.

The two most widely used methods of urinalysis are the enzyme multiplied immunoassay test (EMIT) and radio-immunoassay (e.g., ABUSCREEN) (Klotz, 1990). EMIT detects the presence of substances in the urine through the use of antibodies that attach themselves to target substances. Radio immunoassays are similar to enzyme immunoassays except they use radioactive tracers that attach themselves to the target substances (Klotz, 1990). For each of these substance tests, a positive identification of a substance can be followed by a gas chromography-mass spectrometry (GS-MS) test for confirmation of the findings. The U.S. Department of Health and Human Services in 1988 recommended cutoff levels for the minimum amount of the substance detected during testing for positive findings to be declared. The EMIT and GC-MS cutoff levels are as follows:

	EMIT (in ng/ml.)	GC/MS (in ng/ml.)
Amphetamines	1000	300
Barbiturates	300	300
Benzodiazepines	300	300
Cocaine	300	150
Marijuana	100	15
Methadone	300	300
Opiates	300	300
Phencyclidine	25	25

In a study examining substance use and subsequent impairment on-the-job, Normand, Salyards and Mahoney (1990) analyzed urine samples of postal service applicants using the EMIT technique followed by a GS-MS confirmation of positive findings. Their study involved 21 sites across the nation that sent specimens to a single toxicology laboratory for analysis. In all, 5,465 applicants were tested using U.S. Department of Health and Human Services recommended cutoff levels. Five of the twenty-one sites were also randomly selected to submit 250 urine samples that would serve as quality controls. Fifty of these quality control samples were drug free, 100 contained cross-reactive agents, 50 were spiked with drug metabolites just below cutoff levels for positive detection, and 50 were spiked at levels just above the cutoff levels. Cross-reactive agents contain a portion of the metabolites found in the target substances and, as a result, can attract the antibodies which normally attach themselves to the target substance's metabolites. This was a double-blind quality control estimation because not only were the sampling sites unaware of which samples were controls, but the laboratory was also unaware that any quality controls were being submitted. Of the 250 quality control samples, no false-positive results appeared. The cross-reactants produced 19 positive findings by EMIT, but all of these were correctly negated by subsequent GC/MS. Four false-negative results did appear among the spiked samples. One for phenobarbital, two for morphine, and one for marijuana. Thus, 4 out of 50 known positive samples, or 8 percent, were identified as negative. Thus, in studies reporting substance use rates via urinalysis, it appears that of employees using drugs, roughly eight percent will not be detected. For this set of 250 samples, 20 percent of which are known to be drug positive, urinalysis would indicate an 18.4 percent drug prevalence rate. The lower the base rate of drug use in a sample, the smaller the effect of false negative errors on prevalence estimates. In fact, the most that the false-negative rate could affect the estimate would be 8 percent,

and that would occur only if the entire sample was drug positive. These results suggest that the enzyme multiplied immunoassay technique followed by gas chromography-mass spectrometry gives a relatively accurate estimate of substances in urine samples. There were no false-positives, and an eight percent false-negative rate. False-negatives, or type II errors, are preferred over false-positives, or type I errors, because under most conditions costs associated with false-positive results greatly exceed the costs associated with false-negative results (Normand et al, 1990).

How Prevalent is Licit and Illicit Substance Use in the Workplace?

In 1989, the United States Department of Labor reported an overall nine percent drug and alcohol prevalence rate among workers employed by 7500 different companies with drug testing policies. Despite the substantial accumulation of company reports upon which it was based, this estimate may be high or low because of its nonrandom sampling procedure. Nine percent may be high because firms that have chosen to test for substance use may be doing so because of an existing problem. On the other hand, nine percent may be low because the presence of a testing program may deter substance use. Every study that we examine will have such obfuscating features, and that is why we will look at many different studies in this review. However, the nine percent Department of Labor estimate is a good starting point because of the large sample size upon which it is based and the variety of industries across which it spans.

The ideal study to determine substance use prevalence in the workplace would, of course, randomly select workers from a nationally representative set of worksites, obtain blood and urine samples on site without prior notification, and subsequently subject those samples to double-blind quality controlled drug analyses. Such a study would not be legal because it infringes on employee rights to privacy and as such,

none have been performed. However, several studies have estimated substance use in the workplace through less invasive methods. The rest of this section examines these studies only insofar as they shed light on the prevalence rates of substance use by employed people. Some studies examine on-the-job use while the majority have surveyed employees about their past substance use on or off the job. Most have examined more than just prevalence rates and they will therefore be discussed again in later sections with regard to their other findings.

The first group of studies presented here is based on self-report surveys. Three of the self-report studies are based on large, nationally representative samples and should be given the most weight in estimating overall substance use by both the U.S. population and our subset of interest, employed people.

Prevalence Rates Estimated Using Self-Report Measures

Cook and Harrell (1987) analyzed data collected by the Gallup Organization between May and June of 1985 for the Social Research Group of George Washington University. In this survey, 3000 adults aged 18 and older were interviewed in their homes by trained interviewers. Cook and Harrell report that the sample is representative of U.S. households although they fail to inform us of the sampling methodology. Of the 3000 people interviewed, 1716 were employed outside of the home, and it is this subgroup that Cook and Harrell (1987) studied. Only cocaine and marijuana use were examined. Unfortunately, the questions asked of this sample were not confined to substance use on-the-job (e.g., "When was the most recent time you took (the drug)?").

Eighteen percent of the entire sample reported any marijuana use in the last year, with 11% reporting use in the last month. Six percent reported past year cocaine use with 2% in the last month. When split into five age groups, people aged 18 to 24

and 25 to 34 reported significantly higher rates of marijuana use (19% and 20%, respectively) than the rest of the sample. Thirty-five to 44 year olds reported 6% marijuana use in the last month, 45 to 54 year olds reported 2%, and people 55 and older reported 1% marijuana use in the last 30 days. When the time frame is expanded to one year, the high risk groups of 18-24 and 25-34 year olds report 29 and 30% marijuana use. This rate drops to 11% for 35 to 44 year olds and then down to 2% for people who are older than 45. For cocaine, significant differences between age groups were also found. Eighteen to 24 and 25 to 34 year olds, at 4%, reported the highest rates of use in the past month compared to the average of 2% for the entire sample. For past year use, cocaine rates rise to 12% for both 18 to 24 years old and 25 to 34 year old people.

In 1985, the Eighth National Household Survey of people 12 years of age and older was conducted. This survey was conducted using a multistage area probability design and included 8,083 interviews. Selection probabilities were based on the race/ethnicity of the head of the household and the ages of the residents. If a household was selected, a random sampling procedure of its residents was conducted. People living away from households were excluded from this survey. Notably, this exclusion criterion eliminates institutionalized and hospitalized people as well as college students living away from home. The goal, and likely result, of this sampling procedure was to achieve a nationally representative sample of people living in U.S. households. For the entire sample of employed and unemployed people, 32.4% reported trying marijuana, 11.6% reported cocaine use, 6.7% reported use of hallucinogens, 2.8% had tried PCP, 1.0% had used heroin, and 86.1% reported use of alcohol. When we limit prevalence rates to the subsample of people employed full-time, we find that 43% report any marijuana use, 16.3% report any cocaine use, and 94% report any alcohol use. These prevalence rates are uniformly higher for full-

time employees than the rest of the sample. Analogous estimates from the Household Study conducted by the Gallup Organization (Cook & Harrell, 1987) showed 11.7 percent of full-time employees report marijuana use in the past month and 4% report cocaine use in the past year.

The National Institute on Drug Abuse continued their series of National Household surveys in 1988. This sample was slightly larger than the 1985 sample with 8,814 interviews, and it included the same age range of people 12 years old and older. Although the general study findings have been published by NIDA, the subgroup of employed people has not been separately analyzed. However, if we compare the total sample of employed and unemployed people in 1988 to those in 1985, we find no significant changes in any substance use. For the 1985 and 1988 National Household surveys and the 1985 Gallup Organization Household survey, we see national estimates of substance use among employed persons on or off the job. Unfortunately, from these figures it is difficult to estimate the actual on-the-job use of drugs and alcohol. Nevertheless, we attempt such an estimate later in this report.

A survey of a nationally representative sample of 12,071 young adults directed at substance use in the workplace took place in 1984 and was reported by Mensch and Kandel in 1988. The respondents make up the Youth Cohort of the National Longitudinal Survey of Labor Market Experience (NLSY). This cohort is a stratified area probability sample that is representative of people who were born in the United States between 1957 and 1964. It is part of an ongoing, longitudinal study of the experiences of young Americans that is being conducted by the U. S. Department of Labor (Wolpin, 1983). Ninety-five percent (6,062 males and 6,009 females) of the original sample was interviewed in 1984 at the ages 19 through 27. Participants were asked about past year use of marijuana, cocaine, cigarettes, and alcohol, as well as past month use and whether or not they had ever been "high on-the-job" from any of

these substances. Being "high on-the-job" was defined as ever having used on-the-job or during breaks any of the substances listed. The findings have been reported for men and women separately. For the past year, 42% of the men reported using marijuana and 15% reported using cocaine on or off the job. Eighty-one percent reported alcohol use in the past month on or off the job. For the women, past year use of marijuana was reported by 28% of the sample and past year use of cocaine by 10% on or off the job. Past month use of alcohol was reported by 69% of the women in this study. These estimates are slightly higher than the estimates obtained from the household surveys, possibly because this sample included college students and unemployed people in a high risk age bracket. Recall that the Household surveys systematically excluded college students and included a wide age range. For the men, 5% reported being high on-the-job from alcohol, 8% from marijuana, and 2% from cocaine. For women, the rate of being high on-the-job from any of these substances was reported as 3% for marijuana , 1% for alcohol, and 1% for cocaine.

These data are useful for interpreting the findings of studies that do not report on-the-job substance use. In this sample of 19 to 27 year olds, 19% of men who report any marijuana use also reported doing so in the workplace, and 13% who reported any cocaine use also reported cocaine use in the workplace. For the women, 9% of the marijuana users did so while at work, and 10% of those reporting cocaine use also reported using cocaine on-the-job. Because of the strong influence of age on substance use rates and the relatively narrow age range upon which this conversion ratio is based, we cannot use this method to compare workplace substance use rates from every data set containing past year or month estimates. However, we can apply it to studies that have broken use estimates down by age. For example, Cook and Harrell's survey (1987), which did not ask for substance use in the workplace itself, found that 21% of the males and 13% of the females reported past year use of

marijuana. For employees between 18 and 34, roughly 30 percent reported marijuana use in the past year. Unfortunately, sex differences for every age group are not reported for past year use. But, since there were equal numbers of male and female respondents in each of the NLSY age groups, we can average the 19% for men and 9% for women to equal 14%. That is, in the NLSY study roughly 14% of people indicating any marijuana use also reported using marijuana on-the-job. Multiplying this 14% by the 30% use rate obtained in the Cook and Harrell (1987) study would create a 4.2% averaged on-the-job marijuana use estimate for men and women between 18 and 34 years of age. Similarly, the averaged on-the-job cocaine use rate for males and females would be nearly 1.5 percent. These rates are very similar to the NLSY population averages of 5.5% and 1.5%, respectively. Thus, the Mensch and Kandel data provide a crude means for estimating substance use in the workplace in the past year from substance use anywhere in the past year - at least for young people.

Findings that are discrepant with the 5% marijuana and 1.5% cocaine on-the-job use rates were obtained in a study conducted in Los Angeles, California. According to Newcomb (1988), 42.8 percent of his respondents reported marijuana use in the last month with 20.1 percent reporting marijuana use on-the-job. Any cocaine use in the last month was endorsed by 33.8 percent of the respondents, and 9.3 percent reported cocaine use on-the-job. Because of the limited geographic base for the sample, however, the prevalence rates may not generalize to the population at large. However, this study does suggest that on-the-job use rates may exhibit great regional variation.

Limited generalizability is a criticism that could be leveled against most studies of substance use in the workplace because the majority of the research concerns a single company, a single worksite, or both. However, given the tremendous variability

in workplace substance use estimates across various sites, samples, and reporting techniques, depending on the use to which they will be applied, more specific and qualified findings may be of greater utility anyway. The nationally representative surveys provide rough estimates of overall substance use while the single job type or single company studies can contribute valuable information for those specialized circumstances under which more nationally representative findings do not generalize. In fact, the bulk of the quality data on workplace substance use come from studies such as these.

Newcomb's Los Angeles on-the-job substance use rates seem high not only when compared with national survey findings, but also when compared to the findings of a survey of an electronics corporation in Silicon Valley, California (Browne, 1988). Employees were required to attend a seminar on substance use in the workplace, and during this time they were asked to fill out an anonymous questionnaire. Of those who responded, 90% reported having tried alcohol at some time in their lives, 60% reported ever having smoked marijuana, 40% admitted trying cocaine or crack, and 10% reported trying heroin, methedrine (speed), or other drugs. When asked to indicate substances used at least once a week, 50% endorsed alcohol, 30% endorsed marijuana, 15% endorsed cocaine or crack, and 2% endorsed methedrine.

The most interesting findings, however, concerned the prevalence of substance use in the workplace itself. Ten percent of Browne's (1988) sample reported having used alcohol at work, with 2% using it regularly. Five percent reported using marijuana at work, with none using it regularly. Three percent reported using crack or cocaine at work, with 1% using it regularly. Again, we see the familiar 5% rate of marijuana use on-the-job and a slightly higher 3% cocaine use rate. The cocaine rate may be higher because it includes crack. A couple of limitations to this study are worth noting. First of all, the respondents all work for the same company, making it risky to

generalize these findings beyond companies with, for example, similar pay scales, similar employee demographic features, and similar workplace rules and levels of direct supervision. In addition, Browne does not mention the response rate for her survey. A low response rate would suggest a nonrepresentative sample even within this single company. Perhaps only people with an interest in substance use participated; or maybe heavy users of illicit drugs failed to fill out the questionnaire or lied for fear of being identified. Even with these potential limitations, however, marijuana use estimates are in substantial agreement with the National household surveys and the NLSY study. Cocaine estimates are slightly higher than previous reports of nationally representative samples but substantially lower than Newcomb's Los Angeles study.

Another study conducted with a narrow sample involved 500 teachers in Texas (Watts & Short, 1990). These teachers were asked about substance use either on or off the job. A stratified random sampling of teaching districts and both secondary and primary levels was used. The self-reported prevalence rates of substance use in the last month were as follows: alcohol, 60%; marijuana, 1.8%; cocaine, 0%; amphetamines, 1.1%; barbiturates, 0.7%; and tranquilizers, 0.7%. Bear in mind , however, that actual on-the-job rates are difficult to estimate from these figures, and their generalizability beyond primary and secondary teachers is unknown.

In a study of military applicants, a sample of 10,188 recruits filled out the military's Educational and Biographical Information Survey (EBIS), which included questions concerning past substance use. McDaniel (1988) analyzed these data for their ability to predict being later judged unsuitable on-the-job and discharged. Prevalence reports on substance use from this study are based on responses to the question, 'Have you ever tried . . .?'. Thirty-one percent had tried marijuana, 5% had tried cocaine, 13% reported trying stimulants, and 5% reported trying depressants.

This sample is certainly not representative of the employed population as they are all seeking a position in the military, and there is clearly an incentive not to tell the truth about past substance use for fear of rejection. However, the sample size is large, and while it may not generalize beyond people seeking military service, this information may be relevant for government employers.

An informative study by Walsh et al. (1991) examined the drinking patterns of employees identified with a drinking problem at an industrial plant staffed by 10,000 people. A survey was presented to 224 new clients of the company's employee assistance program (EAP). This sample represents the heaviest of drinkers and indicates how much they consume on-the-job. Walsh et al. (1991) found this sample of problem drinkers averaged 6.2 drinks per day. Twenty percent reported alcohol use on-the-job while 21% reported that they got drunk on a daily basis. Twenty-four percent reported three of more blackouts in the last 6 months, and 25% reported one or more periods in which they were drunk for 24 hours or more in the last 6 months. For the 2.24% of the employees in this company abusing alcohol in sufficient quantities to be referred to the EAP, 20% of them reported drinking on-the-job. With national estimates of workplace substance abuse ranging from 3-5% (Mensch and Kandel, 1990), 20% is probably the highest possible estimate of alcohol use on-the-job, applying only to heavy users.

Rather than use paper and pencil instruments for collecting self-report data, at least two studies used the telephone. The telephone is more economical than face to face interviews for reaching a representative sample of people. This makes achieving a representative sample more likely. However, the same potential problems of honesty and accurate recollection that confound paper and pencil questionnaires apply to telephone surveys as well.

In a telephone survey of Connecticut, Rhode Island, Vermont, and New

Hampshire, 2565 people were asked about their drinking habits (Hingson et al., 1985). A randomized digit dialing program chose phone numbers to be called. A response rate of 75% was obtained in 1982, with a 13% refusal rate. Five percent were missed or had language barriers and 7% could not be contacted. In 1983, the response rate was 78%, with an 11% refusal rate. Seven percent were missed or had language barriers and 4% were not successfully contacted. Among those sampled, 1740 (68%) were currently employed. Of this employed subsample, four percent reported that they had drunk alcohol on-the-job, not including lunch or breaks, at least once in the past month. Eighteen percent report drinking on-the-job when work breaks are included, and 3% reported that they regularly drink more than two drinks during those work breaks.

The second telephone survey took place in Detroit (Parker, 1983). A sample of 1367 employed people were interviewed and classified with respect to alcohol dependence and problem drinking. Alcohol dependent drinkers were those who reported withdrawal symptoms or a loss of control over drinking. Problem drinkers were identified if their drinking caused job disruption, belligerence, social reactions, or consequences of a least moderate severity. For this sample, 6.1% were labeled dependent problem drinkers, 6.3% were classified dependent nonproblem drinkers, 6.8% were classified nondependent problem drinkers, and 71.8% were identified as nondependent nonproblem drinkers. Nine percent abstained from alcohol entirely. Of the problem drinkers, 37% reported consequences on-the-job or elsewhere as a result of drinking. Unfortunately, without knowing consumption rates for 'or elsewhere' it is impossible to compare an estimate for "on-the-job." If all of the reported consequences occurred on-the-job, the percent of the sample effected on-the-job would be 4.8%. This study, like the preceding one in New England, did not examine other substance use.

Based on data collected in the early 1980's, Trinkoff, Ritter, and Anthony (1990) computed the lifetime prevalence of cocaine use in a sample obtained as part of the National Institute of Mental Health Epidemiologic Catchment Area Program (ECA). They defined lifetime use as having ever used cocaine for a total of five or more times. The sample includes an impressive 14,333 people interviewed face to face between 1981 and 1984 at five separate locations. Interviews took place in New Haven, Connecticut, Baltimore, Maryland, St. Louis, Missouri, Durham, North Carolina, and Los Angeles, California. Employed males reported lifetime cocaine use at a rate of 9.3, percent and employed females reported lifetime cocaine use at a rate of 6.5%. The sample studied consisted of adults 18 years of age and older residing in households, chronic care facilities, correctional facilities, or hospitals. No rate of lifetime cocaine use differences were found between these groups, bolstering the generalizability of the household studies cited previously.

Before leaving these self-report based studies, it is worth citing a study that illustrates how varied substance use in the workplace might be among different companies, at least as it is indexed by the perceptions of people who run companies. This survey was conducted by Rosse, Crown, and Feldman (1990). They mailed questionnaires to 500 personnel managers who were selected randomly from the American Society of Personnel Administrators directory. Among other things, the managers were asked to estimate the rate of substance use in their companies. One hundred and twenty seven usable responses were returned. This return rate of 26% practically assures a nonrepresentative sample (for instance, eighty-one percent had participated in formal drug education workshops). This lack of representativeness, however, may make the estimates they obtained more useful to managers who are similarly concerned about workplace substance abuse. That is, these rates would probably not generalize to companies less concerned with the problem. Those

uninterested in the problem would, however, be unlikely to study them anyway. It is also possible that these responders may estimate levels of substance use in their worksites more accurately than managers without drug workshop experience.

In any event, the average estimated rate of employee drug use, excluding alcohol, was 14%. The range, however, was tremendous, starting at 1% and climbing to as high as 75% according to some managers' estimates. The average estimated rate of substance use on-the-job, including alcohol, was 6%. Again a large range was reported, spanning from zero to 44%. Thus, the most illuminating aspect of this study may not be its estimate averages, but the ranges on these averages. If the estimates obtained in this study are accurate, then the prevalence of substances in the workplace varies tremendously from company to company, suggesting the most important determinants of workplace substance abuse are features that also vary widely between companies. If the estimates are not accurate, however, then the vast ranges observed suggest that managers' perceptions of substance use are poorly informed.

Prevalence Rates Estimated Using Blood and Urine Tests

Great variability among estimates of substance use is evident in self-report based studies, while national surveys seem to converge on estimated on-the-job use rates of 5% for marijuana and 1-3% for cocaine. As mentioned before, the second major method for estimating substance use in the workplace is based on blood and urine analyses. Unlike the self-report studies, the validity of these studies is not determined by the honesty and accuracy of recall of their participants. However, the detection of substances in bodily fluids through chemical testing cannot establish use on-the-job. Chemical detection can only determine substance use in the past few days or weeks.

A compelling report on substance use based on urine testing was conducted as part of the California Commercial Laboratory Drug Testing Project, which accumulated the drug results from four different laboratories in California (Anglin & Westland, 1989). These labs run 66,000 drug tests a month for several types of customers, one of which is employers. Over a twelve month testing period, from May 1987 to May 1988, monthly prevalence rates for employees ranged from 1.5 to 7.5 percent for marijuana, 0 to 2 percent for cocaine, and .5 to 2 percent for alcohol. Zero to three percent tested positive for opiates, and zero to three percent were positive for amphetamine. This study did not detect any trends in substance use over those 12 months.

An important caveat to these findings is that the subject population is not random. Many of the companies sending specimens to these labs are testing for cause. This means that when an accident occurs, they take a blood and/or urine sample from those involved. In addition, as with the U.S. Department of Labor (1989) estimate of nine percent substance use on-the-job, companies requesting testing may be doing so because of an established problem. The authors conclude that serious consideration be given to testing in the workplace because the low percentages of substances detected in their high risk subject population do not jibe with popular conceptions of the problem. Anglin and Westland (1989) admit that theirs are likely over-estimates of actual use because they were testing for cause. However, they overlook a second confound that may serve to lower the rates of substance use obtained through chemical testing.

The second confounder of urinalysis studies results when, as is true in most such studies, workers are warned ahead of time that they will be tested. This is necessary to protect their right to privacy. Because of this warning, however, the rates of on-the-job cocaine and alcohol use may be underestimated because people can clean out their systems by abstaining in a matter of days. The monthly detection of 1.5

percent cocaine use and 1.7 percent alcohol use may reflect a complex combination of problem abusers who are not able to stop the substance use before the drug tests and those tested immediately following an accident. Similarly, while the estimates for cocaine and alcohol may be low, the prevalence rates for marijuana use found by the California Laboratories may be high because THC, the active ingredient in marijuana, stays in fat cells for up to thirty days after use. A positive result may occur for an employee who smoked marijuana in the past few weeks during vacation time, not on-the-job. The problems with this study are inherent to this type of research. And whether or not substances were used on-the-job, employers may not want them in their employees' systems. Among urinalysis studies, however, this one is particularly strong because of its large sample size and its coverage of several industries.

Normand et al.'s (1990) study of postal workers provides estimated rates of substance use by people applying for civil service positions. Twenty-one sites across the nation included urine sample drug testing during a physical examination that was mandatory for all applicants. In all, 5,465 people were tested, and 4,396 were eventually hired. At some of the sites, applicants were informed two to five days before testing that a drug test would be performed. For most of the applicants, however, no warning was given until the day of the test. Ten percent of the applicants tested positive for one or more illicit substances. Of that ten percent, 65% were positive for marijuana, 24% for cocaine, and 11% for one or more other drugs. The drug test results were kept independent from the hiring process which was based on a review of past work experience, criminal histories, and the passing of a written exam. For the 80% who were hired, 9% were positive for substance use. Relative to the overall 20% rejection rate, it is interesting to note that 28% of the substance positive group was rejected for reasons other than their substance use even though the substances they used were nearly identical to those used by the total group. How the job performance

of the hired group that tested positive compared with the job performance of hired group that did not test positive will be detailed later in a discussion of the consequences of workplace substance abuse.

A company that continues to test job applicants and also workers who are suspected of substance use is Georgia Power. As part of a larger study, Sheridan and Winkler (1989) reported data on Georgia Power workers tested for cause in 1986 and 1987. Workers involved in an accident or suspected of substance use for other reasons were tested. In 1986, 463 people were tested with 13.4% testing positive for substance use. 4.8% of those testing positive were positive for THC (the active ingredient in marijuana and hashish), 2.2% were positive for cocaine, and 6.5% tested positive for other drugs. In 1987, 366 people were tested and 14.8% were found to be drug positive. 5.2% tested positive for THC, 1.6% were positive for cocaine, and 7.9% were positive for other drugs. Bear in mind, however, that these estimates are based on a sample that is already suspected of substance use on-the-job.

During the month of December, 1986, 359 tractor-trailer truck drivers who stopped in a truckstop west of Brownsville, Tennessee on Interstate 40 were asked to provide blood and urine samples as part of an anonymous drug use survey (Lund et al., 1989). Each participant was given 30 dollars for participating. Sampling occurred at several different times during the day and night. Of the 359 people asked to participate, 38 declined. In addition, 4 drivers either could not or would not provide both a urine and blood sample for the study. Thus, 88% of those initially approached were included in the final sample. It is not possible to determine the extent to which refusals were the result of a fear of being caught using drugs as opposed to drivers simply not having the time to spare. Marijuana was detected in 15% of the drivers and cocaine was detected in 2%. Nonprescription stimulants were detected in 12% of the drivers, with most of them claiming medical reasons for their use. Alcohol was found in

less than one percent of the drivers. The results of this study must be qualified by its single geographic location and the 12% refusal rate.

In 1984, Southern Pacific Railroad began urinalysis of its employees (Taggart, 1989). Testing was done when there was reasonable suspicion of human error contribution to accidents, involvement in a major accident irrespective of obvious cause, or suspicion of having actively or passively contributed to an accident. In addition, all applicants for employment were tested. Urinalysis testing from August to December of 1984 produced a positive substance rate, including alcohol, of 22.9 percent. 370 tests were conducted in that six months. In 1985, an 11.6% substance positive rate was found, and in 1986, the positive rate fell to 5.3 percent for 1,519 tests. This study suggests that regular drug testing in a company is related to reduced substance use by employees. We must be cautious in making a causal inference, however, because other changes may have taken place in the company in addition to the new drug testing policy. However, it seems reasonable to suggest that drug testing played a part in lowering the rate of detected drug positives in 1986 to less than 25% of its level only two years earlier.

To summarize, it is worth returning to the question with which we began: What is the prevalence of workplace substance use? Definitive answers are elusive because of the systematic errors inherent to self-report and urinalysis data. Despite systematic errors that differentially influence prevalence rates depending on the type of substance used, sampling techniques, industry studied, geographic location, and respondent honesty and accuracy, estimates from the U.S. Department of Labor (1989), the California Laboratories Drug Testing Project (1989), the National Institute on Drug Abuse Household Surveys (1985, 1988) and the Gallup Organization's household survey are probably the best available and certainly the most suggestive of a national average.

The urinalysis findings converge on a nine percent substance positive rate on-the-job. The California Labs break down those rates among substances to approximately 5% marijuana, 1% cocaine, 1% alcohol, 1.5% opiates, and 1.5% amphetamines. Among the self-report data, the Household survey reported by Cook and Harrell (1987) places estimates of past year use on or off the job at 18% for marijuana (11% in past month) and 6% for cocaine (2% past month). The National Household survey in 1985 found a past year use of 11.7% for marijuana and 4% for cocaine. Applying the findings from Mensch and Kandel's (1988) Youth Cohort sample to the national household studies provides a crude way to estimate on-the-job use from past year use for marijuana and cocaine. Using this procedure, we estimated 4.2% of Cook and Harrell's national sample use marijuana on-the-job and 1.4% use cocaine on-the-job. These estimates concur with national urinalysis-based findings. Other studies report workplace substance use rates ranging from 20.1% for marijuana and 9.3% for cocaine use by L.A. respondents (Newcomb, 1988) to 1.8% marijuana and 0% cocaine use in the last month by teachers on or off the job in Texas (Watts & Short, 1990). These findings are summarized in Table 1. The vast ranges observed suggest that a fruitful followup question might be, "In what jobs are higher rates of workplace substance use observed?" and "In what types of people are higher rates of workplace substance use observed?"

Table 1

Workplace Substance Use on-the-job(%)

Type of Study	Marijuana	Cocaine	Alcohol	Any
Self Report				
Anonymous Corporation (Browne, 1985)	5.0	3.0	10.0	----
Household Survey (Computed Est.) (Cook & Harrell, 1987)	4.2	1.4	----	----
Los Angeles Sample (Newcomb, 1990)	20.1	9.3	----	----
EAP Respondents (Walsh, 1991)	----	----	20.1	----
National Youth Cohort (Mensch & Kandel, 1988)	5.5	1.5	3.0	----
New England Telephone Survey (Hingson, 1985)	----	----	4.0	----
Pre-employment; Testing for Cause				
U.S. Department of Labor Report (U.S. Dept. of Labor, 1988)	----	----	----	9.0
California Commercial Laboratory (Anglin and Westland, 1989)	4.5	1.5	1.7	----
U.S. Postal Service Applicants (Normand et al., 1990)	6.8	2.3	----	----
Georgia Power Company (Sheridan and Winkler, 1989)	5.0	1.9	----	----
Southern Pacific RR (Taggart, 1989)	----	----	----	14.1

Any Substance Use In The Past 30 Days In Or Away From The Workplace (%)

Self Report	Marijuana	Cocaine	Alcohol	Any
Corporation in Silicon Valley (Browne, 1985)	40.0	20.0	80.0	----
Survey in Los Angeles (Newcomb, 1990)	42.8	33.8	----	----
Survey of Texas Teachers (Watts and Short, 1990)	1.8	0.0	60.0	----
NIDA Household Survey (Cook and Harrell, 1987)	11.0	2.0	----	----

In What Types of Jobs are Higher Rates of Workplace Substance Abuse Observed?

Self-Report Studies

Mensch and Kandel (1988) found no clear patterns of substance prevalence in general or on-the-job across occupations and industries in their sample of young adults aged 19-27 (See Table 2). Therefore, for the 5,335 men and 4,874 women in this sample, two indirect means of quantifying job characteristics were applied to occupations. With the assignment of specific job characteristics to occupations, Mensch and Kandel went beyond substance use comparisons at an occupational level and compared substance use rates at a job characteristic level. For their first approach to quantifying job features, Mensch and Kandel applied a job characteristic scoring system developed by Karasek and his colleagues (Karasek, Schwartz, & Pieper, 1982; Karasek et al., 1988; Schwartz, Karasek, & Pieper, 1982). This method applies to approximately 240 census occupational categories. Karasek's scores derive from self-reports of job conditions provided by three national Department of Labor surveys of workers between 18 and 65 years of age. Karasek adjusted the scores for age, race, marital status, region, and self-employment to reduce the variance within occupations. This allowed for a better comparison between job conditions and types. In all, Mensch and Kandel selected nine specific dimensions for study. These dimensions fall under the categories of: a) decision latitude and control over work, b) role overload (pressure and excessive demands), c) job insecurity (frequent layoffs), d) interpersonal relations at work, and e) physical conditions.

The second approach Mensch and Kandel used to categorize jobs was based on the Dictionary of Occupational Titles (DOT) which, in 1977, provided distinct occupational titles and work descriptions for 12,099 jobs (U.S. Department of Labor, 1977). Mensch and Kandel report that they rated each occupation on 44 worker traits.

They then analyzed these ratings with a factor analysis. Their analysis showed four factors corresponding to substantive complexity, motor skills, physical demands, and undesirable working conditions. Thus, each job had four common characteristics upon which to be compared to other jobs. Mensch and Kandel argue that the DOT provided a measure of a job's intellectual and physical demands while Karasek's scoring system measured the psychological workload and social relations on-the-job.

Mensch and Kandel found correlations between job characteristics and overall drug use either to be statistically not significant or to be of such low magnitude as to be of little interest. For instance, when correlated with substance use, only two categories of job characteristics produced a correlation coefficient greater than .10. As physical demands and exposure to hazards on-the-job ('physical conditions') increased, the use of marijuana on-the-job increased and as the intellectual challenge of the job ('substantive complexity') decreased, the use of marijuana increased. However, despite statistically significant correlations between these two categories of job characteristics and drug use, their associations are weak because the observed significance is largely the result of the large sample size.

Table 2

Use of Selected Drugs for Men in the Workplace by Occupation (%)*

		High on-the-job	
Job Category	Alcohol	Marijuana	Cocaine
Professional and technical workers	4	5	2
Managers and administrative (except farm)	4	2	1
Sales workers	8	7	2
Clerical Workers	6	7	1
Craftsmen	4	10	2
Operatives	2	9	1
Laborers, except farm	6	9	2
Farm Laborers and foremen	0	4	2

* (Mensch & Kandel, 1988)

Cook and Harrell (1987) also categorized jobs. For this sample of 1,716 employed people, significant occupational differences in past month marijuana use were found between their eight occupational groups. No differences were found between groups in level of cocaine use. As in the Mensch and Kandel 1988 study, the highest rates of marijuana use were found among skilled labor (craftsmen) and people employed in sales/manufacturing while the lowest rates were found among clerical and professional/managerial employees. These findings suggest that blue collar workers have higher rates of marijuana use than white collar workers. It should be noted, however, that the between group differences were not large despite their statistical significance. That these findings did not replicate in the Mensch and Kandel study also raises questions about their reliability. Table 3 lists the rates of past month marijuana and cocaine use on or off-the-job found by Cook and Harrell.

Table 3

Past month marijuana and cocaine use among employed adults by type of employment (%) *

Job Category	Marijuana Use past month	Cocaine Use past month
Professional / Managerial	7	1
Business / Farm Owner	13	2
Sales / Manufacturers reps.	15	3
Clerical	7	1
Skilled Trade	16	3
Semi-skilled Trade	12	1
Laborer	10	5
Service Worker	12	4
	X^2=19.5	X^2=6.6
	P < 0.05	NS

* (Cook & Harrell, 1987)

The 1985 National Household Survey (Voss, 1989) also concurred with the Gallup

Organization's Household study (Cook & Harrell, 1987) and the Youth Cohort sample (Mensch & Kandel, 1988) in its finding that skilled laborers have the highest rates of marijuana use (approximately 16%). Thus, the largest, most nationally representative findings agree that skilled laborers and craftsmen have the highest rates of marijuana use, and there is moderate agreement that white collar jobs have lower rates of marijuana use than the occupational average. For none of these self-report studies were significant differences between occupations for cocaine or other drug use discovered.

Urinalysis Studies

Sheridan and Winkler's (1989) urinalysis study of Georgia Southern Power found substance use in different occupations to follow roughly the same proportions as the self-report studies. They examined the proportion of employees found to be positive for drug use in general or THC specifically. Managers had the fewest positive test results at 5.8% while technicians (38.9%) and skilled labor (25%) produced the highest rates of drug positive results. The rates of THC positive drug tests were 2.9% for managers, 16.6% for technicians, and 11.7% for skilled labor. All of these estimates are higher than the self-report survey data because this sample comprises employees tested for cause.

In Scandinavia, because the socialized government provides citizens with both employment and medical coverage, it is possible to maintain a tremendous database of both kinds of information. Olkinuora (1984) used this database to explore rates of alcohol related hospital stays among a variety of occupational categories for a Finnish sample. He found the highest rates of alcohol related hospital stays for men among unskilled workers, painters, seamen, and construction workers, and the lowest rates were among executives and farmers. From his own data and a review of

contemporary research, Olkinuora noted commonly identified job characteristics associated with occupations with high rates of alcohol related hospital stays. He concluded from this that the availability of alcohol at work, social pressure to drink on the job, separation from normal social relationships, and freedom from supervision all contributed to higher rates of drinking.

In 1984, Markowitz tested the proposition that alcohol use is a response to perceived powerlessness on the job. Six hundred and sixty-three surveys were distributed to full-time employees in eleven different organizations. Two hundred and seventy-three usable questionnaires were analyzed for a net response rate of 47%. Several questions asked about employee's personal power in the organization, job autonomy, participation in decision making, and job responsibilities. Four questions were included assessing alcoholism (Mayfield et al., 1974). These four questions were combined to form an alcohol index that was then regressed on the other questions. That is, responses to questions indexing perceived power in the organization, job autonomy, participation in the decision making, and job responsibilities were examined in relation to the four item Mayfield et al. (1974) alcohol index. Markowitz found responses to questions indicating low perceived job responsibility and high organizational powerlessness to be significantly correlated with responses to questions indicating alcoholism. Thus, drinking alcohol at work may be related to lack of perceived power on the job (Markowitz, 1984) and relative isolation from friends and supervision coupled with availability of alcohol and social pressure to drink (Olkinoura, 1984).

In What Types of People are Higher Rates of Workplace Substance Abuse Observed?

The ideal study to identify the types of people who abuse substances on-the-job

would require randomly testing many workers without prior notification in several different worksites from a variety of occupations. As mentioned before, this type of study is not feasible and has not been conducted. Instead, there are a handful of studies that have examined the characteristics of on-the-job substance users through a variety of less optimal methods. The few studies of sociodemographic characteristics of substance using employees in the United States are based on nationally representative random samples. After reviewing their findings we will examine demographic characteristics of substance users as found in studies of more limited scope.

Arguably the best study of sociodemographic characteristics of substance users is provided by Cook and Harrell (1987) using the Gallup Organization's household survey sample. This nationally representative sample of 3,000 people 18 years of age and older was surveyed about their marijuana and cocaine use. Of this sample, 1,716 people were employed. Demographics reported here are for the 540 employed people who reported marijuana use and the 180 employed people who reported cocaine use on or off the job. Of age, sex and education, age was by far the most powerful predictor of marijuana and cocaine use. Significant differences in marijuana and cocaine use were found between age ranges 18-24, 25-34, 35-44, 45-54 and 55 and older. The rates of use in the past month for the two groups under the age of 35 were 20% for marijuana and 4% for cocaine. For the entire sample, 11% reported marijuana use and 2% reported cocaine use in the past month.

Statistically significant sex differences were also evident in this sample with 14% of males and 8% of females reporting marijuana use and 3% of males and 1% of females reporting cocaine use. No significant differences were found when groups were separated according to education. However, when education is examined within age groups, the high risk 18-34 year old group did show significant differences in

marijuana use by education. Thirty-five percent of people with less than a high school diploma reported past month marijuana use while college graduates reported 16% past month use. Thus, the greatest proportion of users in this study was found among male workers under 35 years of age who did not complete high school. See Table 4 for a complete breakdown of the age findings. Bear in mind that these data encompass both on and off-the-job use.

Table 4

Age by Substance Use Breakdown for Employed People*

	Marijuana use Past Month (%)	Cocaine use Past Month (%)	Marijuana use Past Year (%)	Cocaine use Past Year (%)
Age Group				
18-24 (n=194)	19	4	29	12
25-34 (n=482)	20	4	30	12
35-44 (n=412)	6	-	11	2
45-54 (n=276)	2	1	3	2
55+ (n=283)	1	-	2	-
	X^2= 66.7 P < 0.001	X^2= 14.1 P < 0.01	X^2= 100.3 P < 0.001	X^2= 44.9 P <0.001

* (Cook & Harrell, 1987)

Voss (1989) presented demographic characteristics of the entire 1985 NIDA National Household Survey sample, not just of those who were employed. We include this study because it provides demographic information on all U.S. citizens 12 years of age and older who make up the potential workforce. In examining marijuana use, Voss found that with the exception of older adults, lifetime rates of use were significantly lower for blacks and Hispanics than for whites. In addition, he found males use marijuana more frequently than females. Interestingly, Voss found that 18.8% of 18-24 year olds and 19.6% of 26-34 year olds who had ever tried marijuana

had used it more than 100 times. This one in five ratio of people who use marijuana extensively to those who ever tried it approximates the rate of marijuana users who also report using marijuana on-the-job (Mensch & Kandel, 1988). Of course, these data do not allow us to determine whether, in fact, on-the-job users are simply those who are heavy users in the first place. For cocaine, similar sex differences appeared, with men using more often than women. However, racial differences were not as clear. Whites were the greatest users of cocaine, but the difference between the races was not statistically significant. In sum, there exists gender differences in both the quantity and frequency of both cocaine and marijuana use, although these differences are less pronounced among younger than older adults. In addition, whites use drugs more often than other ethnic groups.

The 1988 National Household Survey published by the National Institute on Drug Abuse (U.S. Department of Health and Human Services, 1989) provides further data addressing substance use rates across sex, age, race, and type of substance used. 36.9% of males in this sample and 29.7% of females reported any marijuana use. 13.1% of males and 8.5% females reported cocaine use. Males also had higher rates of hallucinogen and stimulant use than females. People 18-34 years of age reported the highest rates of substance use for both marijuana and cocaine.

Whites, Blacks, and Hispanics reported similar rates of past year marijuana use at 10.3, 10.8 and 10.7 percent, respectively. Hispanics had the highest cocaine prevalence rate, 5.7%, but this was only slightly higher than Whites 4.0% and Blacks 4.4% rates of use. The data from this sample have also been separated by geographic region of the country. In general, the West had the highest rates of respondents ever using an illicit substance, while the South had the lowest rates. Prevalence rates for ever having used marijuana were 38.6% in the West, 34.2% in the North Central, 33.4% in the North East, and 29.5% in the South. For cocaine use,

prevalence rates were 16.2% for the West, 11.8% for the Northeast, 10.9% for the North Central, and 7.1% in the South.

Mensch and Kandel (1988) conducted multivariate analyses of data from the Youth Cohort of the National Longitudinal Survey of Labor Market Experience. These analyses were directed at how job conditions might affect substance use in the workplace. Mensch and Kandel found that both marijuana use and cigarette smoking are predicted for both men and women by the personal attributes indicating a lack conformity or attachment to social institutions. They defined this lack of conformity or attachment as dropping out of school, having participated in delinquent activities, and not being married. In fact, these personal characteristics predicted marijuana use better than job conditions.

McDaniel's (1988) sample of 10,133 military applicants provides another large, although nonrandom, indication of the association between personal characteristics and workplace substance abuse. Based on multivariate analyses, McDaniel found females reporting a lower rate of substance use than males. In addition, he found the most intelligent applicants reporting the least drug use.

Trinkoff et al. (1990) reported on personal characteristics associated with lifetime cocaine use. Lifetime use was defined as six or more occasions on which one used cocaine. The sample studied consists of 14,333 people surveyed at five different locations as part of the National Institute of Mental Health Epidemiologic Catchment Area Program (ECA). As reported earlier, the rate of lifetime cocaine use was higher for employed males (9.3%) than for employed females (6.5%). In fact, prevalence rates for males were higher than for females in every age bracket of every race and ethnic group. Unfortunately, Trinkoff did not report statistical significance tests on his findings believing them to be too exploratory to support formal statistical analyses. Therefore the differences reported below may in some cases not be statistically

reliable.

Trinkoff compared rates of cocaine use between full-time and part-time employed men and women and found large differences between the groups for women. Up to the age of 40, women employed full time reported higher rates of cocaine use than those who were not employed full time. The only difference between full time and part-time employed men appeared among 25-29 year olds where 19.8% and 14.3%, respectively, reported lifetime cocaine use.

In analyses of marital status/living arrangements, Trinkoff found married respondents had the lowest rates of use in every age group whereas people under 40 who were unmarried and cohabitating had the highest rates (up to 44.7% for 25-29 year olds). These data replicate Mensch and Kandel's (1988) nationally representative study of 19-27 year olds. Further, Trinkoff found that college attendance, regardless of graduation, increased lifetime prevalence of substance use. Dropping out of high school increased the rate of cocaine use in the 18-24 years of age bracket where the rate peaked at 15.8%. Among females, whites had the highest rates while for the males, rates by race varied with age, although generally white males had the highest prevalence rates. The authors' conclusions regarding sociodemographics of cocaine users were that people who dropped out of high school and who had unconventional living arrangements were at high risk as were highly educated, white males 25-34 years old.

Unfortunately, the two urinalysis studies that conducted large cross-industry testing for drugs did not report on the sociodemographic data for their samples. However, two more limited urinalysis studies did report sociodemographics.

Normand et al. (1990) analyzed data from 5,465 applicants to the U.S. Postal Service. Among these applicants, 10% were found to be drug positive. The analysis of drug test results by race, sex, and age group showed that the rates of positive drug

tests were higher for blacks, men, and applicants between 25 and 35 years of age. Black applicants tested positive 15.01% of the time, which is significantly higher than the 7.15% positive rate for whites. Blacks were more than six times as likely as Whites to test positive for cocaine and almost twice as likely to test positive for marijuana. This conflicts with the findings from Trinkoff et al. (1990) and Voss (1989) who found whites to be the highest lifetime cocaine and marijuana users. Whether this difference is attributable to nonrandom samples or to measurement differences between self-report data and urinalysis is indeterminate from presently available information. As the other studies reported have found, the highest risk group for substance use was 25 to 35 years olds with significantly more men (10.04%) than women (7.42%) testing positive overall.

In a study at Utah Power and Light (UP&L), subjects were tested for cause and compared to a control group matched for age, sex, job classification, years of service, and geographic distribution (Crouch et al, 1989). Substance positive employees were characterized as being between 32 and 37 years of age, commanding a salary less than the company mean, and having been employed for 7 to 13 years. Again, males had a higher rate of use than females.

To summarize, sociodemographic studies suggest that men between 25 and 35 years of age are the highest users of drugs and alcohol. In addition, both Trinkoff (1990) and Mensch and Kandel (1988) found that being single and living under nontraditional arrangements were associated with drug and alcohol use. Finally, the 1988 NIDA survey found the highest substance use rates in the West for both cocaine and marijuana. The South enjoyed the lowest prevalence rates for both drugs. Addressing potential racial differences, Voss (1988) found Whites to be the highest users of marijuana while no consistent pattern appeared for cocaine. The 1988 NIDA survey found that Hispanics had higher cocaine prevalence rates than Blacks or

Whites although no statistical tests were reported. Normand's U.S. Postal Service findings indicate significant racial differences in drug use with blacks testing positive significantly more often than other races. However, this sample is not representative of the entire workforce. Thus, little agreement can be reported among studies of racial differences in drug use.

Cook and Harrell (1987) examined educational effects, finding evidence that college graduates have lower rates of substance use and that people under 24 who have dropped out of school also have increased substance use rates. On the other hand, Trinkoff's (1990) multisite study found higher rates of cocaine use for people who had attended college regardless of graduation. Because of these contradictory findings, few conclusions can be drawn about the effects of education level on substance use.

What are the Consequences of Substance Use in the Workplace?

Pre-employment drug testing: Testing for cause

Research on the prevalence of substance use in the workplace indicates that roughly 5% of employees use marijuana on the job, 1 to 2 % use cocaine on the job, and that other illicit drugs are used by roughly 5% of workers. Sociodemographic and job characteristic analyses show that substance use appears at similar rates in all occupations and that young males are the largest users. The question that is perhaps equally important, however, is "What effect does substance use have on employees?" The ideal research design to answer this question would involve manipulating the use of substances by employees and recording changes in productivity and safety as these substances are introduced and removed from the workers' systems. This, however, is obviously not possible. Urinalysis studies may offer the best evidence of substance use consequences because companies test for substances in workers

following accidents and before employment. Currently available urinalysis studies, however, have subject pools limited to a single company. Self-reports of substance use consequences offer economically feasible alternative ways to obtain information, although respondent honesty and accuracy still may influence the data. Another group of studies involves reviews of workers' files comparing current knowledge of substance use with past performance on the job. The major problem with these data is that current substance use does not equal past substance use. There is no way to know if the employees were under the influence of drugs or alcohol when past incidents occurred. Finally, controlled studies of alcohol and marijuana use have been performed that indicate long lasting effects of these drugs beyond initial 'highs.'

Available research has targeted behaviors such as accidents, absenteeism, tardiness, and increased turnover rates as potential effects of worker substance use. Normand et al. (1990) tested employees for substance use upon their application to the U.S. Postal Service. Applicants were hired without knowledge of the drug test results. After an average of 1.3 years of employment, potential on-the-job behavioral correlates of substance use were recorded and compared between those who tested positive for substance use and those who tested negative at pre-employment. Compared to pre-employment negative employees, Normand found 59% more absenteeism and 47% more involuntary turnovers for pre-employment drug positive employees. No differences were found for accidents or for injuries on the job. Although highly suggestive, these findings leave many questions unanswered. Employees were categorized as drug users or nonusers on the basis of a single pre-employment drug test. Substance use at the time of the examined incidents is unknown. In addition, some workers may no longer have used drugs or alcohol and some who previously did not use them may have started. Finally, it is unknown whether the apparent differences are caused by substance use or by personality

differences. People who choose to use drugs may also more often be absent from work for reasons not associated with their drug use and are fired as a result. If so, then there would be no direct effect of substance use on absenteeism or involuntary turnovers.

Like the U.S. Postal Service study, a study at Utah Power and Light (Crouch et al., 1989) found statistically significant increases in absences for drug positive employees and users of their employee assistance program. Drug positive employees in this study consist of pre-employment drug positive employees and employees testing positive following an incident on the job. The study at Utah Power and Light took place in an effort to understand the consequences of employee substance use. Four groups were formed and compared for absenteeism, medical benefits use, and accidents. Group one consisted of people who tested positive for substances during pre-employment testing and/or testing for cause. Group two consisted of employees who voluntarily joined the company's employee assistance program. Groups three and four served as control groups for groups 1 and 2, respectively, being matched on age, sex, job classification, years of service, and geographic distribution. The number of people in each group was relatively small with 12, 47, 27, and 108 employees in each group, respectively.

Drug positive employees took significantly more sick hours and unexcused absences than their matched control group. The two groups were equal in the amount of vacation days taken. The difference in absentee time between drug positive employees and their control group over the course of one year was 55.7 hours per employee. For the EAP participants, statistical differences between groups appeared for sick days and unexcused absences but not for vacation time nor for the mean total number of hours absent. If we ignore the use of vacation time, which is higher for the control groups, drug positive employees had approximately eight more days absent

from work and EAP users had approximately six more days absent relative to their respective control groups. Greater differences for the drug positive employees suggest that people who volunteer for the company's EAP may not have as serious a problem as employees who try to cover their use but are detected by a drug test. Or, the EAP may have positive effects.

In addition, Crouch et al. (1989) found significantly more accidents occurring for both pre-employment drug positive employees and EAP users. Despite this increase in accidents, however, these accident prone employees used fewer medical benefits than the control groups. Crouch also examined the "at fault" rates for accidents and found that the pre-employment drug positive employees were at fault in 80% of their accidents while drug negative employees were at fault only 50% of the time. These percentages were, however, derived from small sample sizes (5 accidents and 4 accidents) and should therefore be viewed with caution. The accident rate disparity suggests that pre-employment drug positive workers were more reckless on-the-job. Whether they were on drugs or alcohol at the time of the accidents, however, is still unknown.

In 1987, the National Institute on Drug Abuse sponsored a two year study to evaluate drug testing in the workplace at Southern Electric International, Inc. (SEI) and Integrated Systems and Applied Technologies, Inc. A subsidiary of SEI is Georgia Power which Sheridan and Winkler (1989) have studied. At Georgia Power, drug testing of all employees takes place upon employment application. For all of the applicants, prior notification is given that the drug test will occur before employment. Drug tests are also performed to prove current employee fitness for duty and following aberrant behavior or accidents on the job. Nuclear plant employees and security personnel also must submit to regular drug tests. The rest of the sample comprises EAP users. Of these people, the company selected drug negative employees matched

on job classification, length of employment, sex, race, and age as a comparison group. Promotions, demotions, jobs held per year, and absenteeism were examined. In 1986, 463 employees were tested for drug use and in 1987, 366 were tested. Across occupational categories and ages, the only subgroup of the drug positive employees to have significantly more hours of absenteeism than their drug negative counterparts were employees between the ages of 31 and 40. Significantly higher substance use rates appeared in either 1986 or 1987 for managers, skilled laborers, professionals, and 41-50 year olds. Marijuana use was not related to absenteeism rates for any subgroup. Among other factors related to testing positive, turnover rates, as indicated by jobs per year, was significantly higher and participation in the company automatic savings plan was lower than for the entire workforce and the control group. Unexpectedly, number of demotions per person was significantly higher for employees testing negative than for the entire workforce. The authors explain that this may be the result of people being fired after being found drug positive while those who are drug negative are demoted following aberrant behavior.

Self-Report Studies

McDaniel (1988) surveyed over ten thousand 1983 military recruits and examined the correlation between pre-employment assessment of substance use and later performance in the military. Each recruit filled out a self-report questionnaire that asked about current and past substance use. Frequency, quantity, the last time the substance had been used, and the first time the substance had been used were assessed with this self-report measure. Roughly four years later, McDaniel analyzed the relationships between variables on the self-report measure and being discharged from the military for reasons classified as "failure to meet minimum behavioral or performance criteria." McDaniel found that the earlier people begin using drugs, the

more likely they are to be classified as "unsuitable for service." McDaniel also found high frequencies of substance use and past criminal records to be associated with being discharged from the military for "failure to meet minimum behavioral or performance criteria." The findings from the pre-employment and testing for cause studies are presented in Table 5 below.

Table 5

Consequences of Substance Use

Study Sample	Examined Criteria	Drug User Rates versus Nonuser Rates
Postal Service	Absenteeism	+59%
	Involuntary Turnover	+47%
	Accident Rates or Injuries	No Difference
Utah Power	Unexcused Absences	+240%
	Excused Absences	+35%
	Number of Accidents	+500%
	Medical Benefits	-71%
Georgia Power	Unexcused Absences	+155%
	Demotions	Less Frequent
	Rate of Turnover	Higher
Military Applicants	Classified as Unsuitable for Service	Higher

From these studies, it appears that employees who test positive for drugs before being hired are absent more often, experience a higher rate of turnover, and possibly suffer more accidents. However, two other types of research, self-report studies and retrospective studies, do not support the tentative finding that accidents and substance use at work are related.

A phone survey of 1740 employed people that took place in 4 New England States found no overall relationship between drinking alcohol and accidents on-the-job (Hingson, 1985). Respondents admitting to occasional drinking during breaks did not have significantly more accidents on-the-job, and reports of arriving to work high or hungover were not related to work accidents. Not surprisingly, when these self-report

data were analyzed by breaking the subjects into two groups, abstainers and persons who drink 5+ drinks a day, differences were observed. The rates of criterion events for heavy drinkers relative to abstainers were as follows: 1.7 times more accidental injuries (at or away from work), 3.8 times more injuries requiring hospitalization, and 2.0 times more job-based accidental injuries. In 74% of the cases, accidents required missing one or more days from work. It appears that *excessive* drinking either on-the-job or away from it can affect the attendance of employees. Finally, employees who reported drug use while at work in the month preceding the interview had a 1.7 times greater chance of being injured in an accident and 2.4 times greater risk of that accident resulting in a hospital admission.

A 1-800 COCAINE hotline received 362 calls from employed people in 1988 who were then surveyed concerning their cocaine use (Herridge and Gold, 1988). 98% of the callers were calling because they felt that they had "bottomed out" and needed help with their problems. The other two percent were concerned about drug testing at work. Although this sample can accurately be described as heavy cocaine users, despite their anonymity only 1% of the callers admitted to suffering substance use related accidents on the job. Less than 5 % of the men and 1% of the women admitted a job loss related to substance use. This survey also found 61% of the men and 45% of the women admitting to being late to work or calling in sick because of drug use. Table 6 below presents the findings from these two self-report assessments of substance use and its consequences.

Table 6

Self-Reported Effects of Substance Use

Study Sample	Examined Criteria	As Compared to Abstainers
Phone Survey	Number of Accidents for:	
	Illicit Drug Users	+170%
	On-the-Job Drinkers	No Difference
	Employees with Hangover Effects	No Difference
	Employees Consuming 5+ Drinks/Day	+337%

		Reported by Substance Users
1-800-Cocaine Hotline	Work Accidents Caused by Drug Use	1%
	Loss of Jobs Due to Drug Use	
	Males	5%
	Females	1%
	Absent or Late Due to Drug Use	
	Males	61%
	Females	45%

In a study of British alcoholics in the park service a lower number of accidents were recorded in the files of nonalcoholic workers than in the files of alcoholic workers (Beaumont & Hyman, 1987). File records did, however, indicate more excused absences for alcoholic workers. One-hundred files of workers identified as problem drinkers in the departments of cleansing, parks and gardens, and building and works were examined for the period spanning from 1978 to 1983 for comparison with records of nonalcoholic workers over the same period. Files of problem drinkers contained fewer reports of accidents than those of the control group. In addition, fewer days absent followed alcoholics' accidents than accidents of nonalcoholics occurring for the alcoholics than for the non-alcoholics. Of course, these data do not reveal whether these workers were under the influence of alcohol while on the job or even whether

they were alcoholics during the time span studied. Table 7 summarizes these findings.

Table 7

File Report Study

Study	Examined Criteria	Alcoholics versus Nonalcoholics
British Park Service	Reportable Accidents	Fewer
(Alcohol Only)	Days Absent Due to Accidents	Fewer
	Excused Absences	Greater

Because the evidence from these correlational studies does not jibe with popular conceptions of the detrimental effects of workplace substance abuse, it is also worth examining experimental studies. The results of these studies could serve as guides to future correlational research on workplace substance use by directing attention to worker performances that are most likely to be impaired. Such studies could dramatically improve upon those that are currently available. Studies also enjoy much greater degrees of control over extraneous obfuscating factors, although this is achieved at the expense of apparent naturalness of setting.

Experimental Studies

Price and Flax (1982) tested eight male college students on drill press operation and precision under four levels of alcohol consumption. One to two days after they had practiced up to a stable level of performance, subjects drank vodka and orange juice to reach blood alcohol concentrations (BAC) of .03, .06 and .09%. (The legal limits for driving vary around .05 to .08% in the United States.) Eight levels of task difficulty with two levels of incentive were built into the study's design. Four predictions were made by the researchers. First, they expected that as BAC went up, the number of good units produced would fall. Second, as BAC's increase, the

accuracy of performance should decrease. Thirdly, as task difficulty increases, the effect of the alcohol should become more pronounced. Finally, the researchers hypothesized that increasing BAC would have greater effects when subjects were instructed to work "carefully" than when they were instructed to work "quickly."

For the BAC of .06% and .09%, the number of good units produced fell significantly relative to baseline performance after the training sessions. The loss in productivity was 12% for .06% BAC and 19% for the .09% BAC levels. However, accuracy of drill press operation was not related to the BAC level of the subjects, and as task difficulty increased, the effects of alcohol did not become larger. Nor did the careful versus quickly incentive distinction result in significant BAC effects. Thus, it appears that high levels of alcohol consumption lead to lower productivity through slower work habits.

Yesavage and Leirer (1986) examined hangover effects on pilot performance. Ten Navy P3-C Orion pilots flew two simulated flights under a control (no alcohol) condition and a hangover condition. In the hangover condition, each pilot drank from 5-7 glasses of wine 14 hours before testing. All subjects reported previous social drinking, but none reported a history of heavy drinking. Six measures of pilot performance during a simulated flight were then computer rated. On one of the six measures of performance, the pilots performed significantly more poorly in the hangover condition than the control condition. On three of the six variables, the variability of the pilots' performances increased significantly. That is, their performances on three of the variables became significantly more erratic in the hangover condition. The one significantly poorer performance was recorded for average takeoff yaw, or angle of ascent. The three measures with significantly increased variability were takeoff heading, landing heading, and average vertical distance from the glideslope. Interestingly, the pilots perceptions of their flying skills

did not reflect the measured differences. The effected pilots were unaware of any change in their skills.

Yesavage et al. (1985) reported similar findings in a study designed to measure the hangover effects of marijuana. Ten experienced and licensed pilots trained for 8 hours on a flight simulator task. Each then smoked a cigarette containing 19 mg. of THC. One, four, and 24 hours later they were each tested on the flight simulator. All subjects had previously smoked marijuana so this was not a new experience for any of them. The eight variables measured included number of aileron changes (lateral control), elevator changes (vertical control), throttle changes, the size of the control changes, the distance off-center of the runway on landing, the average lateral and vertical deviations from an ideal glideslope, and distance from center line over the final mile of approach. One and four hours after smoking THC, all eight variables differed significantly from baseline except for the number of throttle and elevator changes. Twenty-four hours after smoking THC, significant changes were evident on four of the eight variables. In addition, significant increases in the variability of two of the measures occurred, suggesting looser control over the plane. Subjective measures of anxiety, alertness, and mood did not differ between the 24 hour trial and the baseline measures, indicating that these pilots were unaware of any change in their conditions 24 hours after smoking marijuana.

Chait et al. (1985) examined the hangover effects of marijuana on cognitive functioning. In his study, subjects were randomly assigned either to smoke a cigarette with THC or a cigarette without THC in his lab the evening before a cognitive test assessment. Equal THC intake was maintained through the measurement of expired air carbon monoxide levels before and after smoking. The following day, people who smoked the cigarettes with the active THC performed significantly worse than the control group on a short term memory task and on an information processing task.

Kagel, Battalio and Miles (1980) found contradictory effects of marijuana use in a study designed around a microeconomy based on manual weaving of sash belts on primitive, portable handlooms. Sixty subjects were recruited through a newspaper advertisement to participate in three different studies. Subjects lived in the Addiction Research Foundation hospital for several weeks and were paid for sash belts that met a quality criterion. All of the materials needed to make the sashes were available at any time, and participants were allowed to work wherever and whenever they wished. Thus, absenteeism and tardiness were not relevant dependent variables in this study. However, hours worked and output per hour were recorded as was the consumption of marijuana on the job and the total number of acceptable sash belts produced. In this microeconomy, all food and drinks had to be purchased with money earned from the sash belts. Other retail goods could be purchased from a purchasing agent at current market rates. Rental fees were charged for the use of entertainment facilities.

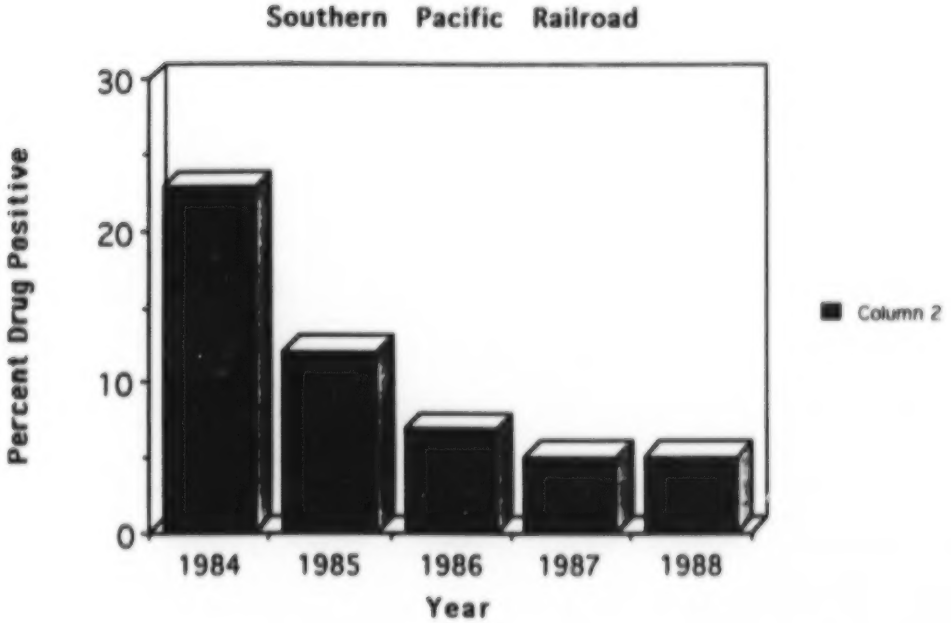
The first 17 days of each study, subjects trained themselves to create satisfactory belts without marijuana available. Then, in one study, subjects were instructed to smoke two 8 mg. THC cigarettes in the evening and one more 8 mg. THC cigarette was made available for purchase during the day. Then for the next 15 days, purchase of 12 mg. THC cigarettes was allowed. A control group followed the same procedures but smoked normal cigarettes instead. In the other two studies, two 8 mg. THC cigarettes were smoked each night as in the first study, but unlimited smoking of cigarettes containing 2 mg. of THC was also allowed. Results of these studies showed that smoking marijuana did not effect either the total output or the total hours worked by the subjects. Low productivity did occur immediately after smoking THC cigarettes, but this loss in productivity was made up over the course of the day. Surprisingly, when inexpensive THC cigarettes were available without restriction, there was a negligible increase in smoking.

To the extent that we can generalize from experimental studies of highly trained pilots and a microeconomy, it would appear that under controlled conditions alcohol and marijuana adversely effect complex cognitive and physical performances, even after several hours have past, but that simple, repetitive tasks requiring limited cognitive skills can be performed satisfactorily even under the influence of marijuana. If so, this might help explain why rates of marijuana smoking are higher for craftsmen and skilled laborers compared to other occupational categories (Tables 2 & 3).

In what might be considered a quasi-experimental study of the effects of workplace substance abuse on worker performance, Southern Pacific Railroad began a drug testing program in August of 1984. Railroad management was concerned about several conditions that seemed to influence the rates of substance use in their industry. Railroad employees are largely skilled or semi-skilled laborers, they are often away from home for long periods of time, they usually work in unsupervised groups, and many railroad tasks are tedious and monotonous. In addition, management felt that because railroad workers operate fast moving vehicles containing a variety of potentially hazardous materials through urban and rural areas of the country, it would be critical for these operators to be fully cognizant of their surroundings and to perform at optimal levels. For this reason, a urinalysis testing program was implemented in 1984 to detect and hopefully reduce the percentage of drug affected employees. This program entailed pre-employment drug testing and testing for cause after incidents in which employees were suspected of substance use. The testing program was, in fact, associated with a decline in the rate of positive test results, with significant reductions occurring each year of the program with the exception of 1988 when the rate seems to have bottomed out at 5% (see Figure 1).

Figure 1

Effects of Drug Testing on the Rate of Positive Urinalyses at Southern Pacific Railroad



During this drug testing program, Southern Pacific Railroad also collected data on human factor related train incidents to see if the reductions in drug positive rates were associated with commensurate reductions in accidents. The number of incidents, the ratio of incidents per 1 million miles traveled, and the dollar damage due to these incidents are shown in Table 8. We cannot conclusively declare that fewer human factor accidents are occurring because fewer employees are using substances in the workplace. Over this time period the employees may have received better training, the supervision or equipment may have been upgraded, weather may have improved, or other things might have changed. But these findings also appear for the Utah Power and Light Company which implemented a drug testing program for their employees. In

1985, the Utah Power and Light Company began prescreening their applicants and in 1986, testing for cause was implemented (Crouch et al, 1989). After implementing this drug testing policy, the number of accidents fell at the Utah Power and Light Company as did the cost associated with injuries deriving from vehicular accidents on the job. Again, we cannot say conclusively that the drug testing at Utah Power and Light lowered the number of accidents because of other possible workplace influences. However, it is accurate to say that after implementing drug testing programs at Southern Pacific Railroad and the Utah Power Company, detected rates of substance use fell as did the number, and costs associated with, of human factor accidents.

Table 8

Southern Pacific Railroad
Human Factor Related Train Incidents

Year	Incidents	Ratio*	Dollar Damage
1983	911	22.2	$ 6,439,677
1984	449	10.5	$ 5,490,356
1985	295	8.1	$ 4,076,133
1986	168	4.2	$ 1,204,477
1987	135	3.2	$ 3,119,822
1988**	93	2.2	$ 1,546,733

* Incidents per 1,000,000 train miles.

**Prorated from the first seven months of 1988.

Clearly, its drug testing program saves Southern Pacific Railroad millions of dollars each year. Incident expenses before drug testing (1983 & 1984) were nearly three times as great as they were after drug testing (1986 & 1987). Whether such savings can be expected in other industries is the question addressed by the next section of this review.

What is the Cost of Workplace Substance Use?

Contemporary estimates of the loss to American business caused by substance use range from 58.3 to 100 billion dollars annually (Rosse et al., 1990; Rice et al, 1991). Some of these estimates are impossible to evaluate because their computational algorithms are not provided. Among these undocumented estimates we find The Metropolitan Life Insurance Company which estimated the direct costs to industry from lost time, productivity, and injuries to be 85 billion dollars per year (as cited by Cohen, 1984) and Backer (1987) who estimates the losses at 60 billion dollars per year. The Department of Health and Human Services (as cited by Harwood, 1991) projects the cost of substance abuse in 1991 to be 144 billion dollars when health services, criminal justice, the loss of potentially fruitful careers to prison, and estimated loses from decreased workplace productivity and premature mortality are also included.

The most recent and well articulated estimate is the 58.3 billion dollar estimate computed by Rice et al. (1991). They discuss and analyze in detail the financial components that they considered relevant in making their 58.3 billion dollar cost estimate. These components include core costs, related costs, direct and indirect costs, morbidity and mortality costs. Because this is the only study to provide sufficient methodological detail for our evaluation, it is considered here at length. Core costs are those accidents and health care costs resulting directly from substance use. Related costs stem from expenses associated with retraining new employees and other nonhealth concerns. Subsumed by core and related costs, direct costs represent payments that are made for personal health care, hospital care, physician and professional services, legal defense, police protection, and property destruction. Indirect costs reflect resources lost to accidents and theft. Morbidity costs result from productivity lost to an inability to perform up to potential, and mortality costs indicate

the losses from early death caused by substance use.

In attaching numbers to these costs, Rice et al. (1991) began by delineating two general approaches that can be invoked, the human capital approach and the willingness to pay approach. In the human capital approach, "an individual is seen as producing a stream of output over time that is valued at market earnings" while with willingness to pay values are set according to what people would be willing to pay for the services rendered by the person. Rice et al. chose the human capital approach with which to make their estimate. Under this approach, Rice et al. chose a period of time over which to observe the costs of each component. For that time period, they used data from the National Hospital Discharge Survey and the National Ambulatory Care Survey for estimating the direct costs associated with medical care. The National Mortality Detail File provided the number of deaths from substance use, and morbidity costs were achieved via Epidemiologic Catchment Area surveys.

The total economic costs of drug abuse totaled 44.1 billion dollars in 1985 according to Rice et al.'s (1991) computations. Of this total cost, direct and support costs accounted for 5%, indirect morbidity costs accounted for 14%, indirect mortality for 6%, and other related costs for 74%. The largest proportion of other related costs, 32.5 billion dollars, breaks down into 13.2 billion dollars from direct crime, 4.4 billion from workers lost to prison due to addiction, and 14 billion dollars from the loss in productivity of people who engage in crime instead of legitimate work. According to Rice et al. (1991), the largest costs of substance use derive not from increased accidents and absenteeism but from the loss of employees to prison and alternative lifestyles that do not increase this country's GDP.

Normand's (1990) study of postal employees also provides an analysis of the costs associated with workplace substance abuse. Based on increases in absenteeism and turnover rates observed among workers who had been drug positive

upon application to the postal service, Normand computed the costs to the postal service in one year to be four million dollars. Over the tenure of employment for the entire cohort observed, savings of over fifty-two million dollars would be realized if they had not hired the drug positive applicants.

The large range of prevalence estimates and the lack of agreement about the consequences of drug use in the workplace make nation-wide generalizations about the costs of substance use perilous. More reasonable conclusions can be reached about individual companies. For both the U.S. Postal Service and the Southern Pacific Railroad company, substance use was clearly associated with significant costs. Although difficult to compute precisely, this is probably true for other industries as well.

Conclusions

Over the past several years, concern about substance use has grown substantially. In an attempt to understand whether the magnitude of this concern is matched by the magnitude of the problem, self-report surveys sponsored largely by the National Institute of Drug Abuse have generated a variety of substance use rate estimates across different segments of the population. And concerns for substance use has not been limited to government agencies. Employers who fear that drug problems may be detrimental to their workplaces have begun urinalysis testing of job applicants and employees exhibiting aberrant behavior. Self-report studies provide lower-bound estimates of substance use in the workplace because they depend upon respondent honesty and accuracy of recall. Urinalysis studies of individual companies are also not optimal means with which to compute representative prevalence rates, rather the drug tests exist as deterrents to potential drug users. The data accumulated from these urinalysis studies also come from nonrandom samples techniques and cannot be generalized to workers in general. Employees warned ahead of time of a

drug test may discontinue using it, corporations that test regularly may have already reduced the rates of substance use, while companies that have recently begun to test for drugs may be doing so because of a suspected problem. This review has presented findings from both self-report and urinalysis studies in order to develop a range of prevalence estimates. Insofar as the literature allowed, the consequences of workplace substance abuse were also examined.

The nationally representative self-report studies largely agree on a 5% prevalence estimate for on-the-job use of marijuana. Employee on-the-job use of cocaine was estimated at 1-3%. On-the-job estimates for other drugs were not reported for these large samples although past month use of hallucinogens was estimated at approximately 1% with heroin and PCP at less than .5% in one study. Large scale urinalysis reports for the most part concur with findings of the self-report studies. The U.S. Department of Labor (1989) produced an overall drug use estimate of 9% by compiling the detection rates of over 7500 U.S. companies with drug testing programs. In California, where substance use is slightly higher than the rest of the country, on-the-job rates for marijuana use ranged from 1.5 to 7.5%, for cocaine use they ranged from 0 to 2%, opiate use ranged from 0 to 3%, and amphetamine use ranged from 0 to 3%. Individual company studies indicated an even wider range of drug use rates. Marijuana use on-the-job ranged from under 2% to over 20% and for cocaine the range was 0 to almost 9% depending on the company studied.

We next sought to determine whether certain worker characteristics were associated with workplace substance abuse. Demographic studies indicate that age is the strongest predictor of substance use. The second strongest demographic variable appears to be sex followed by education, race, and geographic region. The most likely users of drugs in the workplace are white male high school dropouts 18-34 years of age in the Western United States.

Job characteristics were not strongly related to substance use although weak relationships were found for perceived lack of power within the company and relative isolation from supervision. Generally speaking, white collar workers had lower rates of detected substance use than blue collar workers.

The consequences of substance use appear to include increased absenteeism, tardiness, and possibly accidents on the job. The strongest support for these finding come from the urinalysis studies. However, the urinalysis studies are generally dependent on pre-employment testing. Because instances of absenteeism, tardiness, and accidents are not directly tied to substance use, the connection is tenuous at best. For instance, all of the effects attributed to substance use because of positive urinalysis findings during pre-employment screening could also be attributed to personality. It is possible that people who decide to use drugs are also more often late to work and careless on the job because of generally irresponsible predispositions rather than substance use. Therefore, while these consequences are probably related to substance use, substance use may not be the cause of absenteeism, tardiness, and accidents.

Future research would profit from using random samples assessed across industries with both self-report surveys and urinalysis testing. The use of both techniques would capitalize on the strengths and possibly offset the weaknesses of each. Although a fairly substantial corpus of data have accrued addressing the prevalence, correlates, and consequences of workplace substance abuse, before more definitive conclusions can be reached both researchers and their funding agencies will need to rise to the challenge of larger, more difficult, randomized, experimental, and laboratory research. Only then will the database support a transition from impressionistic to empirical policy-making among decision makers at all levels.

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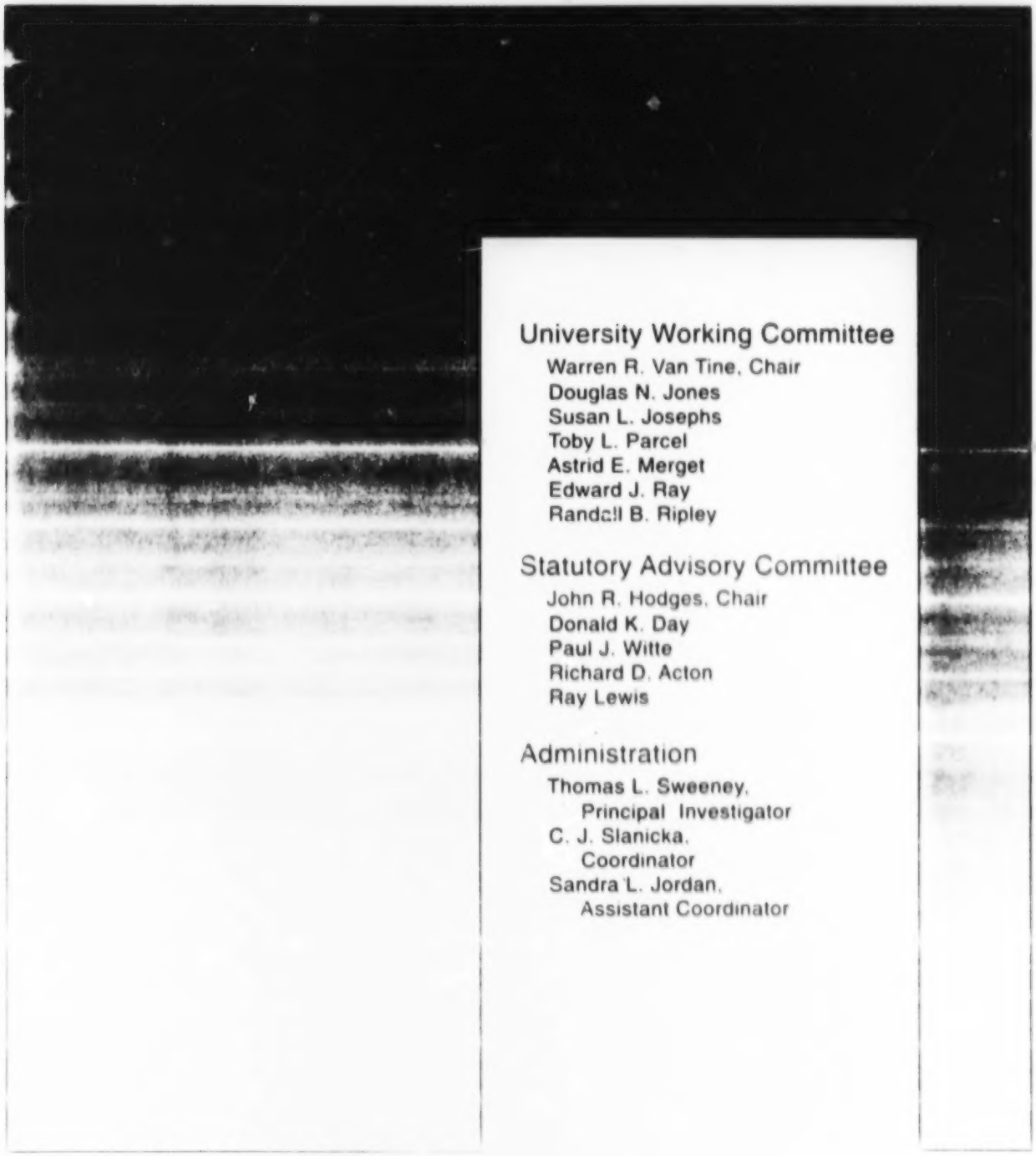

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